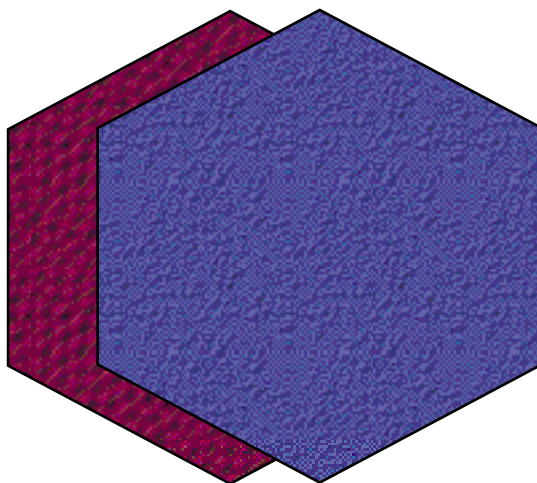


**Iowa**

**CONTENT STANDARDS  
and  
BENCHMARKS**

**Industrial Technology**



**1999**

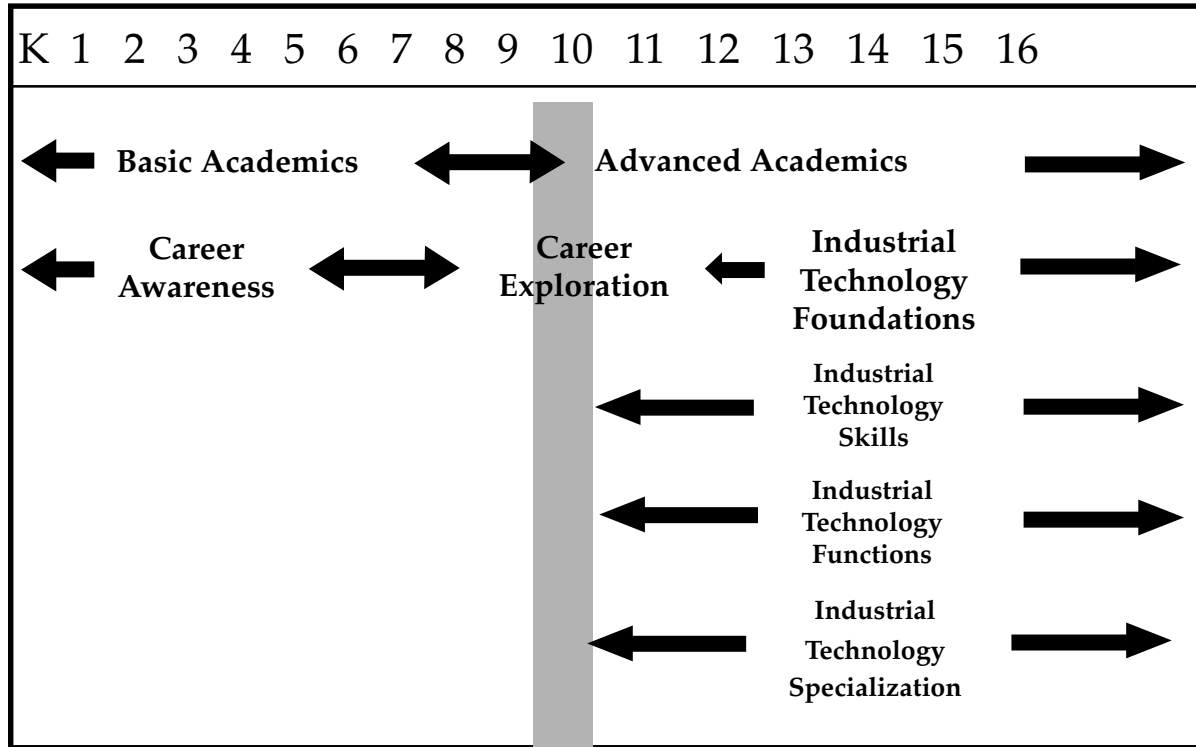
# Engineering/Industrial/Technological Sciences Career Pathway

## Illustration of Program Possibilities

Career and Technical Programs Specific Technical Knowledge and Skills	Occupational Cluster Knowledge and Skills	Career Area Knowledge and Skills	Employability	Academic
Graphic Communications Technical Drawing Photography Radio/TV Printing Telecommunications	Communications	Content and Knowledge of Career Areas—Standards and Benchmarks (K-12)	Employability Knowledge and Skills—Standards and Benchmarks (K-12)	Academic Knowledge and Skills (K-12)
Carpentry HVAC Plumbing Building Trades Construction Equipment Operation Masonry Wiring	Construction			
Industrial Maintenance Manufacturing Engineering Production Production Planning & Control Sales/Marketing	Manufacturing			
Automotive Collision/Repair Automotive Mechanics <small>(automotive, aviation, marine, terrestrial, space)</small> Diesel Engine/Mechanics Automotive Services Small Engine Repair Truck and Bus Driving	Transportation			
Electrical Technology Electronics Environmental Control Industrial Electrician Line Worker Aircraft Maintenance Power Mechanics	Power & Energy			

K-14

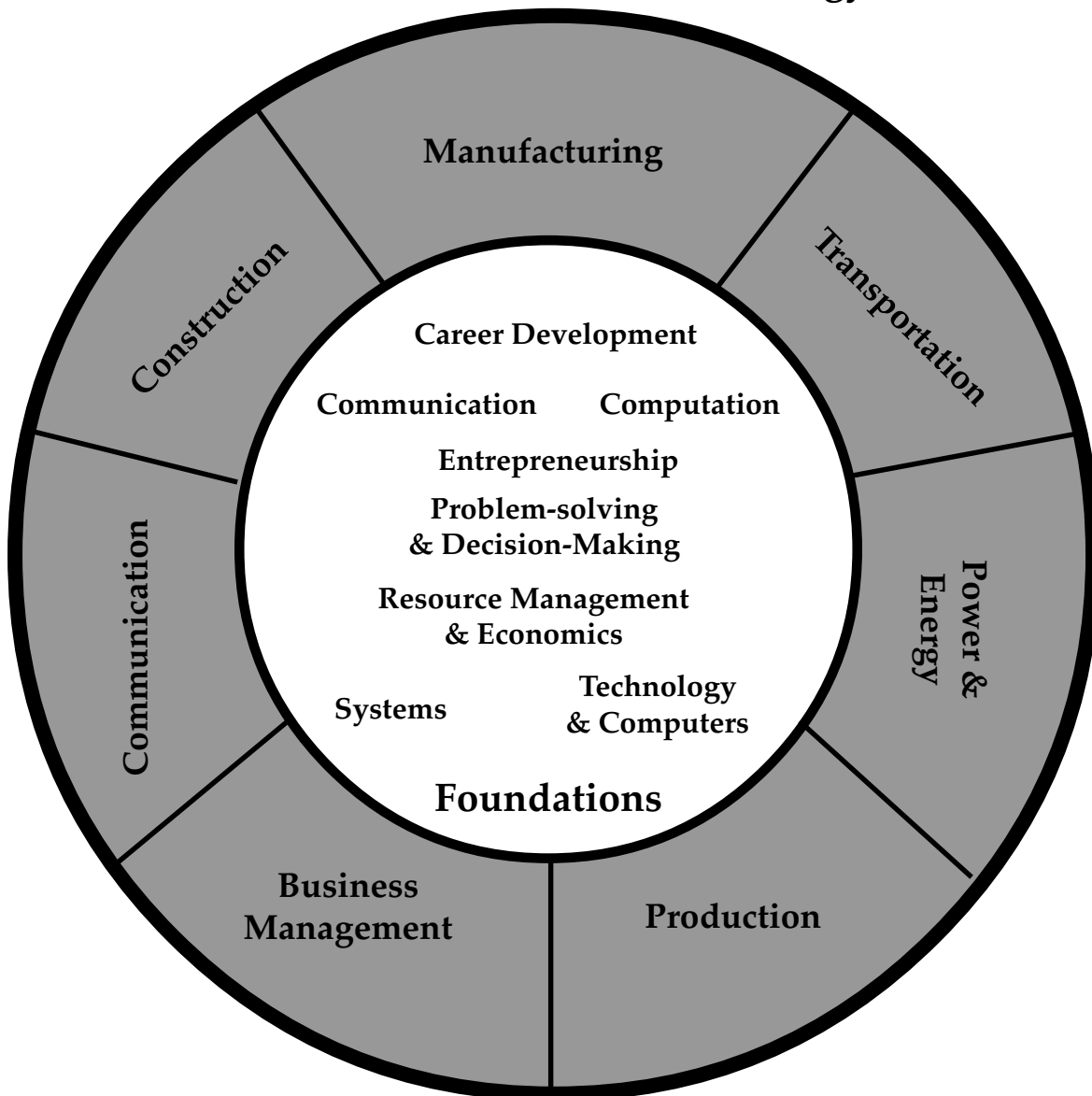
## The Industrial Technology Curriculum



This flow chart describes how the industrial technology curriculum can be viewed as a continuum that begins in the primary grades with career awareness and exploration. The model continues through postsecondary education with the emphasis becoming more specialized to the student's individual interest in industrial technology.

# Curriculum Framework for Industrial Technology

## Functions of Industrial Technology



Academic concepts • Technology

# COMMUNICATION

## Graphic Communications

### Standards and Benchmarks

#### General Requirements

**Standard I: Understand and use the basic fundamentals of the graphic communications industry.**

##### *Benchmarks*

1. Define the role of graphics in the free enterprise system.
2. Identify printing markets and types of printing businesses.
3. List printing's ranking among other industries.
4. Identify the major printing processes.
5. List the advantages of each major process.
6. List the disadvantages of each major process.
7. Identify the products produced by each major process.
8. List in order the business flow of printing from initial need to final product.
9. List in order the technical production flow from idea to finished product.
10. Identify major occupations in the graphic arts.
11. List the major responsibilities for each occupation.
12. Identify basic salary / wage expectation ranges for local area.
13. Measure linear dimensions for printing materials in inches and fractions of inches.
14. Measure type in points and picas.
15. Measure volume for mixing chemicals for darkroom and pressroom operations.
16. Measure copy for reduction and enlargement using various methods to determine percentage setting.
17. Identify locations of fire safety equipment.
18. Describe proper use of fire safety equipment.
19. List safety rules involving flammable liquids.
20. List the steps to be taken in case of injury in the lab.
21. Identify location of first aid kit and eye wash station.
22. Read and comprehend Material Safety Data Sheets.
23. Identify protective safety equipment where needed (gloves, goggles, ear plugs).
24. Follow proper safety procedures when operating equipment.
25. Follow approved shop dress code for safe operation including necessary personal safety equipment.

## **Art and Copy Preparation**

### **Standard II: Demonstrate the basic design process.**

#### *Benchmarks*

1. Identify basic equipment and hand tools for paste-up.
2. Identify basic materials and supplies for paste-up.
3. Produce a simple paste-up using the correct procedures, equipment, tools and materials.

## **Electronic Imaging**

### **Standard III: Demonstrate the basic techniques for electronic imaging.**

#### *Benchmarks*

1. Choose type using correct size and format.
2. Identify fundamentals of type and its uses.
3. Identify the various kinds of items that can be designed and produced using desktop publishing.
4. Demonstrate a keyboard typing proficiency of 30 to 40 W.P.M.
5. Organize a file management system for opening, copying, saving, and deleting files.
6. Demonstrate file management operations for opening, copying, saving and deleting files.
7. Log-on/boot-up and print out a page layout program and demonstrate a functional knowledge of computer commands/codes/menus/palette for the software in use.
8. Set text with appropriate margins, formatting, gutters, leading headings, etc.
9. Flow copy from word processing program to page layout program according to job specifications.

## **Reproduction Photography**

### **Standard IV: Understand and demonstrate the basic photography techniques.**

#### *Benchmarks*

1. Identify basic darkroom equipment and hand tools.
2. Identify basic materials and supplies for line photography.
3. Produce a good quality line negative using sensitivity guide/scale.
4. Identify basic diffusion transfer exposure and processing equipment.
5. Identify basic diffusion transfer materials for making line prints.
6. Produce good quality line print using diffusion transfer process.
7. Make a half-line negative.

## **Image Assembly/Platemaking**

### **Standard V: Understand and demonstrate the basic printing techniques.**

#### *Benchmarks*

1. Identify basic stripping equipment and hand tools.
2. Identify basic stripping materials and supplies
3. Produce a single color flat with correct dimensions and cut outs.
4. Make necessary corrections to flat (ie; opaque / scribing).
5. Identify platemaking equipment and tools for offset metal plates.
6. Identify plate material types and processing chemicals for making offset metal plates.
7. Produce a correctly exposed and processed metal plate for offset printing.
8. Identify direct transfer platemaking equipment.
9. Identify direct transfer plate and processing materials.
10. Produce a direct transfer plate for offset printing.
11. Identify pin registration.

## **Basic Offset Press**

### **Standard VI: Understand and demonstrate use of the basic offset press.**

#### *Benchmarks*

1. Identify basic offset duplicator parts and operations.
2. Identify basic safety and operation procedures for an offset duplicator for single color printing.
3. Perform basic setup for printing a single color job.
4. Produce a printed single color job using an offset duplicator.

## **Bindery**

### **Standard VII: Identify and demonstrate basic bindery processes.**

#### *Benchmarks*

1. Identify operational and safety parts of a paper cutter.
2. Identify grain direction of paper.
3. Calculate basic paper cuts from stock sheet.
4. Draw a master cutting diagram for making cuts.
5. Make accurate paper cuts using a mechanized paper cutter.
6. Identify basic paper types, weights, grades and classifications used in the printing industry.
7. Identify padding equipment and hand tools.
8. Identify padding materials.
9. Produce correctly made pads of paper.
10. Identify stapling and stitching equipment and hand tools.
11. Identify stapling and stitching materials and supplies.

12. Produce side and saddle stitched / stapled products.
13. Identify punching / drilling equipment and hand tools.
14. Measure to drill 3-ring notebook pages.
15. Make holes for 3-ring notebook.
16. Identify folding equipment and hand tools.
17. Identify basic folds for printed products.
18. Make a single fold using an automatic folding machine.
19. Identify collating equipment and hand tools.
20. Make sets of paper using collating equipment in proper sequence.
21. Hand collate sets in proper sequence.
22. Identify die cut products and the basic procedure for diecutting.
23. Identify hot foil stamped products, basic equipment materials and procedures for foil stamping.

**Additional Standards and Benchmarks available from PrintED are:**

- |                                   |  |
|-----------------------------------|--|
| 1. Basic Offset Press             | 5. Reproduction Photography                |
| 2. Electronic Imaging             | 6. Advanced Electronic Prepress            |
| 3. Finishing / Binding            | 7. Advanced Image Assemble and Platemaking |
| 4. Image Assembly and Platemaking | 8. Advanced Press Operations               |



# COMMUNICATION

## Technical Drawing

### Standards and Benchmarks

#### Fundamental Drafting

##### **Standard I: Understands and uses basic drafting techniques.**

###### *Benchmarks*

1. Use and maintain basic drafting equipment and machines.
2. Use architectural, metric, civil, and mechanical engineer's scales and demonstrate scaling techniques.
3. Identify and draw the various line types.
4. Demonstrate correct lettering techniques (freehand or CAD)
5. Reproduce drawings (e.g., blueprints and plots).
6. Prepare drawings/ designs using appropriate media
7. Perform basic geometric constructions
8. Construct and bisect lines, arcs, and angles.
9. Construct perpendicular and parallel lines
10. Construct geometric shapes (e.g., pentagon, hexagon, octagon)
11. Construct drawings of tangent lines, arcs, and ellipses.
12. Draw orthographic views and transfer features.
13. Freehand sketch orthographic and pictorial views.
14. Apply basic dimensioning techniques.
15. Construct basic sectional views.
16. Construct axonometric, oblique and one and two point perspective drawings.
17. Construct drawings of primary and secondary auxiliary views.
18. Solve mathematical problems related to drafting (e.g., conversion of units).
19. Use drafting references and standards.
20. Identify common manufacturing and construction materials.
21. Identify and select types of fasteners, bearings, seals, springs, keyways, and piping components (e.g., pipe schedules, fillings, etc.)
22. Construct object intersections and developments.
23. Identify appropriate manufacturing processes.
24. Use precision measuring instruments.
25. Calculate tolerances and fits.
26. Construct and interpret geometric dimensioning and tolerancing symbols.
27. Read and interpret a variety of drawings.

Note: A substitute for Standard 1 is Part I of the CADD Skill Standards, National Occupational Skill Standards, Computer Aided Drafting and Design, January 1999, National Coalition for Advanced Manufacturing, [www.nacfam.org](http://www.nacfam.org)

## Computer Aided Drafting

### Standard II: Use computer and peripheral devices to aid in the documentation for design projects.

#### *Benchmarks*

1. Demonstrate basic CAD operations.
2. Demonstrate proper care and maintenance of CAD equipment and software.
3. Demonstrate proficiency in creating two-dimensional CAD drawings.
4. Demonstrate proficiency in creating three-dimensional CAD drawings.
5. Demonstrate proficiency in three-dimensional CAD modeling.

Note: A substitute for Standard 2 is Part III of the CADD Skill Standards, National Occupational Skill Standards, Computer Aided Drafting and Design, January 1999, National Coalition for Advanced Manufacturing, [www.nacfam.org](http://www.nacfam.org)

## Design Drafting Applications

### Standard III: Apply technical drawing skills to actual projects.

#### *Benchmarks*

1. Construct keyway and keyseat drawings.
2. Construct spline and gear drawings.
3. Construct cam and follower drawings.
4. Construct fastener head drawings.
5. Construct schematic and simplified thread drawings.
6. Interpret and construct welded assembly drawings.
7. Construct casting drawings.
8. Construct drawings of molded plastic parts.
9. Construct sheet metal or flat pattern drawings.
10. Construct exploded and orthographic assembly drawings.
11. Construct an architectural presentation drawing with site plan (i.e., landscape symbols), floor plans, building elevations and wall sections.
12. Construct various section and detail drawings (i.e., stairs, walls, roofs).
13. Construct interior and exterior elevation drawings.
14. Construct framing plans.
15. Develop, construct and dimension a residential floor plan layout.
16. Construct foundation/basement plans.
17. Prepare window, door and finish schedules.
18. Construct a building perspective drawing.
19. Construct drawings of electrical diagrams (i.e., schematic, connection, interconnection).
20. Prepare a building material list.
21. Construct drawings for heating, ventilation, and air conditioning (HVAC).  
Prepare drawings for plumbing fixtures and piping layout.

# CONSTRUCTION

## Standards and Benchmarks

### Safety

**Standard I: Understand the basic safety and safety operating procedures necessary for a construction project.**

*Benchmarks*

1. Comply with shop and equipment safety rules.
2. Inspect workplaces for safe working environment and report unsafe conditions.
3. Correct safety hazards.
4. Clean and maintain work area and leave in safe condition.
5. Follow tool checkout and maintenance procedures including reporting of equipment failures.
6. Demonstrate proper shoveling and lifting techniques.
7. Explain the application of first aid interventions for particular situations.
8. Explain OSHA job safety compliance.
9. Implement and comply with OSHA job site safety rules.

### General Requirements

**Standard II: Understand the basic background knowledge required for entry into the construction industry.**

*Benchmarks*

1. Cut material to specified dimensions and shape.
2. Install and remove fasteners properly (i.e., nails, screws, and anchor bolts).
3. Measure and compute using fractions and decimals.
4. Measure accurately and use the following instruments; ruler, tape measure, chalk line, level, transit, and square.
5. Explain the importance of estimating to the construction trade.
6. Identify the parts of a structure from a cross-section on a blueprint.
7. Identify basic materials for a particular trade or process.
8. Identify anchors, hangers and supports and their appropriate use of each trade.

## **Preplanning**

**Standard III: Understand the basic sequence of procedures necessary for a construction project.**

### *Benchmarks*

1. Receive, inspect, inventory, stack, and properly store equipment, materials, and supplies on-site.
2. Interpret a materials list.
3. Explain the cost of doing a job to include labor, tools, materials and overhead and their relationship to profit.
4. Compute the quantity of commonly used materials needed for a job (i.e., area, cubic area, and linear measurement).
5. Identify parts and materials using a suppliers' and manufacturers' catalog/manual.

## **Sitework**

**Standard IV: Understand the processes and activities that must be completed to prepare a site for construction.**

### *Benchmarks*

1. Explain how to prepare a building site to include the following: establish elevation reference points from bench mark; establish footing grades; locate and square corners; install batter boards; set grade stakes; and lay out building using transit.

## **Construction Processes**

**Standard V: Differentiate among and apply the appropriate methods and processes to various construction materials and their installation.**

### **Concrete**

#### *Benchmarks*

1. Explain all components of preparing foundations and footings.
2. Build forms for concrete including the erection of wall forms to include anchor bolts, bulkheads and key-way on an appropriate footing.
3. Pour, screed and finish concrete.
4. Strip and clean forms.
5. Demonstrate appropriate handling and placing techniques.

### **Masonry**

#### *Benchmarks*

1. Explain bonding of masonry walls.
2. Explain joint finishes.
3. Demonstrate appropriate mortar mixing techniques.
4. Demonstrate appropriate layout techniques for inside and outside corners.

## **Metals**

### *Benchmarks*

1. Measure, cut, form, fit, and install metal flashing.
2. Measure, cut and install metal siding.
3. Measure, fit and install metal trim.

## **Woods and Plastics**

### *Benchmarks*

1. Identify parts of a stair and compute rise, run, and headroom.
2. Rough in wall, roof, and floor systems.
3. Install cabinetry and case work.
4. Miter and install molding trim.
5. Install prefab truss or rafter roof system.
6. Lay out structural members on center.

## **Thermal and Moisture Protection**

### *Benchmarks*

1. Identify the side wall and ceiling insulation, vapor barriers, ventilation and air infiltration.
2. Identify types of roofing systems including common standards associated with roofing (i.e., flashing, penetrations, and installation).
3. Install insulation.
4. Observe appropriate waterproofing and drainage procedures.

## **Door and Windows**

### *Benchmarks*

1. Install prehung door and/or precased window.

## **Finishes**

### *Benchmarks*

1. Identify different types of exterior finishes (i.e., cornice, door, window, siding, fascia, and soffit).
2. Identify the pros and cons of exterior finishes (i.e., stucco, wood, masonry, aluminum, and vinyl).
3. Identify different types of interior finishes for molding trims, cabinets, doors, hardware, walls, etc.
4. Explain the proper procedures for preparing a surface for finishing and selecting a proper finish (i.e., wood, metal, and masonry).
5. Demonstrate appropriate techniques for installing and finishing drywall.
6. Identify various floor-covering options.

## Equipment

**Standard VI: Use the appropriate equipment for the particular situation.**

### *Benchmarks*

1. Inspect climbing equipment and demonstrate the setup of ladders, ladder jacks, planks, and scaffolds.
2. Maintain and utilize basic hand and power tools from one of the following: hacksaw, circular saw, handsaw, screwdrivers, drills and bits, carpentry, masonry, electrical, HVAC, plumbing.
3. Explain the use of earth moving site preparation equipment in preparing construction sites.
4. Explain proper safety procedures for a safe working environment regarding on site construction vehicles (forklifts, bulldozers, track loader backhoes, dump trucks, etc).
5. Explain proper safety considerations for work in or near open excavations.

## Electrical

**Standard VII: Apply basic electrical techniques.**

### *Benchmarks*

1. Splice a wire correctly.
2. Wire and diagram the following switching arrangements: a. 3-way switching system on one light; b. a single pole switch on one light; c. a single pole switch on two lights; and d. a duplex receptacle.
3. Identify and explain ground fault protection, and where they are required.
4. Identify types and sizes of wire, wire coverings and appropriate short circuit protections.
5. Identify types and sizes of electrical conduits and demonstrate connection techniques.
6. Identify the method of transporting electrical power from generating station to utilization locations.
7. Diagnose malfunctions of simple electrical systems using test and measurement equipment and repair; such as voltmeter, amp meter and ohmmeter.
8. Read and explain information given on motor nameplates.
9. Observe the installation and connection of an electrical service entrance and breaker box.

## Mechanical

**Standard VIII: Understand the basic mechanical procedures involved in the construction industry.**

### *Benchmarks*

1. Explain the difference between the components and operation of the following HVAC systems: steam, hot water, forced air and unit ventilation, air conditioning, and solar systems.

## Plumbing

**Standard IX: Understand the basic plumbing procedures involved in the construction industry.**

*Benchmarks*

1. Explain the installation of water faucet and water closet replacement.
2. Identify the plumbing system in a structure (i.e., ventilation, sewage, potable water, etc.).
3. Identify the components and functions of sanitary and storm sewer systems in a community.

Note: Program Standards and Benchmarks may be taken from:  
National Center for Construction Education and Research, [www.nccer.org](http://www.nccer.org)

# MANUFACTURING

## Standards and Benchmarks

### General Requirements

#### Standard I: Understand and apply the fundamentals of manufacturing.

##### *Benchmarks*

1. Apply basic emergency first aid techniques.
2. Comply with school district rules.
3. Inspect, clean and organize work area and equipment for appropriate equipment use.
4. Identify various manufacturing enterprises.
5. Identify and maintain handtools for a specified job.
6. Measure parts with metric and English systems.
7. Discuss mechanical advantage applications.
8. Set up and use power saws.
9. Recognize when cutting tools need reconditioning or service. Clean and store precision measurement tools, handtools, cutters, jigs, fixtures, and grinding wheels.
10. Demonstrate proper care and storage of lab tools.
11. Perform maintenance procedures on lab equipment.
12. Explain career pathways in manufacturing occupations.
13. Explain industrial relations in manufacturing.

### Processes

#### Standard II: Understand and apply manufacturing processes.

##### *Benchmarks*

1. Explain various classes/types of finishes.
2. Cut threads with various processes.
3. Process materials with portable power tools.
4. Measure parts using precision measurement tools (i.e., micrometer, vernier, dial calipers, and dial indicators).
5. Measure, calculate and layout precision patterns.
6. Apply jigs and fixtures for machine operations.
7. Set up and use precision machining equipment.
8. Explain destructive and nondestructive methods of testing.
9. Identify and explain hydraulic systems.
10. Identify and explain pneumatic systems.
11. Identify and explain electrical systems.
12. Identify valves and control systems.



## **Production**

### **Standard III: Understand and demonstrate production techniques.**

#### *Benchmarks*

1. Interpret and use prints, charts, diagrams, tables, and graphs.
2. Draw sketch of desired work piece (manual or CAD).
3. Develop bill of materials.
4. Plan operation flowchart for production.
5. Explain CAD/CAM/CNC and robotics and describe its use in flexible manufacturing system(CIM).
6. Utilize advanced math skills in product design and development.

## **Materials**

### **Standard IV: Understand and demonstrate the use of materials in manufacturing.**

#### *Benchmarks*

1. Demonstrate material fabrication.
2. Identify ferrous and non-ferrous materials and their use.
3. Demonstrate material conditioning processes.
4. Demonstrate material finishing processes.
5. Demonstrate material separating processes.
6. Demonstrate material forming processes.
7. Demonstrate material combining processes.
8. Demonstrate material casting processes.

## **Manufacturing Enterprise**

### **Standard V: Understand the planning and operation of all aspects of a manufacturing enterprise.**

#### *Benchmarks*

1. Identify the organizational need for profit.
2. Identify opportunities for profit in manufacturing processes.
3. Identify possible barriers to profit in manufacturing processes.
4. Explain the effect of quality on profit.
5. Apply continuous quality improvement to the manufacturing process.
6. Recognize a business plan that provides for an acceptable profit.
7. Explain the importance of a business reputation and business ethics.
8. Identify steps within manufacturing processes that determine cost.
9. Create a project plan.
10. Describe how marketing effort affects product sales.
11. Identify the criteria involved in package design.
12. Identify situations where robots are useful.

13. Understand the elements necessary in designing and developing a product.
14. Explain how logos and trademarks are established for a company.
15. Describe the cash flow of a typical manufacturing enterprise.
16. Explain the relationship of inputs, processes, and outputs.
17. Explain how a legal company is established.

# POWER AND ENERGY

## Technical Service

### Standards and Benchmarks

#### Safety

**Standard I: Understand the basic safety and safe operating procedures necessary in the field of technical service.**

*Benchmarks*

1. Explain appropriate first aid interventions.
2. Inspect work area and equipment for safe working environment.
3. Comply with shop and equipment safety rules and report violations.

#### General Requirements

**Standard II: Understand the basic operations of the technical service industry.**

*Benchmarks*

1. Interpret component identifiers and read schematics (i.e., color codes, manufacturers, and type number).
2. Identify schematic symbols and read and interpret electronics schematic diagrams.
3. Explain the relationships between energy, power and work.
4. Remove and replace components on printed circuit boards using soldering and de-soldering equipment.
5. Record data, plot curves and graphs, and analyze results of laboratory experiments.
6. Write technical reports, which document methods, results, and conclusions.
7. Identify major governing bodies which set standards relevant to the industry (i.e., military, IEEE, UL, ANSI, NFPS, etc.)
8. Identify specific characteristics of various electronic devices using manufacturers' reference manuals.
9. Cross-reference various electronic devices between manufacturers' reference manuals.
10. Interpret control diagrams for electrical systems.
11. Diagnose malfunctions of electrical systems using test and measurement equipment (i.e., fuses, circuit breaks, relay and solenoid failure, etc.).
12. Determine maintenance procedures using technical manuals.
13. Explain the importance of preventative maintenance and the recording of repair activities.
14. Disassemble, fit, straighten and reassemble parts.
15. Measure parts with precision tools (metric and English).
16. Read and interpret basic three views and three-dimensional drawings.
17. Use basic shop skills of stripping wire, soldering, de-soldering, IC sockets, wire wrap, and assembling connectors.

18. Use basic power and hand tools associated with electronic and electrical service.
19. Explain statistical process control (SPC) and how it is utilized in industry for quality control.
20. Explain and demonstrate surface mount technologies.

## DC Circuits

### Standard III: Understand and demonstrate the basic concept of DC Circuits.

#### *Benchmarks*

1. Explain the concepts of DC current.
2. Demonstrate an understanding of sources of electricity in DC circuits.
3. Demonstrate an understanding of principles and operation of batteries.
4. Demonstrate an understanding of measurement of resistance of conductors and insulators and the computation of conductance.
5. Demonstrate an understanding of magnetic properties of circuits and devices.
6. Explain the basic circuit components of resistance, capacitance and inductance.
7. Analyze, construct and troubleshoot series, parallel, and series-parallel circuits.
8. Explain Ohms law ( $R=E/I$ ) and the variables of resistance, voltage and current.
9. Analyze, construct and troubleshoot resistance x inductance (RL), resistance x inductance x capacitance (RLC) circuits.
10. Explain the power formula ( $P=EI$ ) and the variables of power, voltage and current.

## AC Circuits

### Standard IV: Understand and demonstrate the basic concepts of AC Circuits.

#### *Benchmarks*

1. Analyze, construct, and trouble shoot resistance x capacitance (RC), resistance x inductance (RL), resistance x inductance x capacitance (RLC) circuits.
2. Analyze and apply principles of transformers to AC circuits using a schematic (e.g., single and three phase).
3. Explain the power formula ( $P=EI$ ) and the variables of power, voltage and current.
4. Demonstrate an understanding of sources of electricity in AC circuits.
5. Demonstrate an understanding of the properties of an AC signal.
6. Demonstrate an understanding of the principles of operation and characteristics of sinusoidal and non-sinusoidal wave forms.
7. Demonstrate an understanding of basic motor/generator theory and operation.
8. Demonstrate an understanding of measurement of power in AC circuits.
9. Demonstrate an understanding of the principles of operation of safety grounding systems: (lightning arresters, ground fault interrupters, etc.).

## **Analog Circuits**

**Standard V: Understand and demonstrate the basic techniques of analog circuits.**

### *Benchmarks*

1. Set up and operate frequency counters, signal generators, oscilloscopes, multimeters and power supplies.
2. Analyze, construct, and troubleshoot basic power supplies, filters and regulators using a schematic.
3. Analyze, construct and troubleshoot oscillators using a schematic.
4. Analyze, construct and troubleshoot basic modulation circuits using a schematic.
5. Explain electrostatic discharge sensitivity (ESDS) and the application of preventative practices.
6. Identify basic principles of electric motor operations.

## **Discrete Solid State Devices**

**Standard VI: Understand and demonstrate the basic techniques of discrete solid state devices.**

### *Benchmarks*

1. Explain the characteristics of PNP, NPN, and FET transistors including amplification, saturation and cut-off.
2. Analyze, construct, and troubleshoot simple common base, common emitter, and common collector transistor amplifiers using a schematic.
3. Identify optoelectronic and fiber optic devices and explain their operating principles.
4. Analyze, construct and troubleshoot differential and operational amplifiers using a schematic (both discrete and integrated circuits).
5. Define basic sensor types (e.g., tactile, video, fiber-optic, magnetic, thermal, sonic, pressure, and microwave).

## **Digital Circuits**

**Standard VII: Understand and demonstrate the basic components of digital circuits.**

### *Benchmarks*

1. Explain the concept of integrated circuits.
2. Analyze and troubleshoot basic digital logic gate integrated circuits using a schematic.
3. Analyze, construct and troubleshoot basic digital circuits (i.e., flip-flops counters, registers, etc.)

## Microcomputers

### Standard VIII: Understand and demonstrate basic applications of the microcomputer.

#### *Benchmarks*

- Perform appropriate keyboarding.
- Demonstrate an understanding of microcomputer operating systems.
- Demonstrate an understanding of essential microcomputer components.
- Demonstrate an understanding of microcomputer peripherals.
- Set up and configure a microcomputer using available operating systems and software packages.
- Troubleshoot and repair microcomputers and peripherals.

## Microprocessors

### Standard IX: Understand and demonstrate basic applications of the microprocessor.

#### *Benchmarks*

1. Explain the binary system of a microprocessor.
2. Describe and define branching and flow-charting.
3. Explain simple machine language programs (e.g., arithmetic).
4. Prepare simple program to perform interface operations with switches and light emitted diodes (LED's).
5. Demonstrate an understanding of microprocessor interfaces.
6. Demonstrate an understanding of essential microprocessor components.
7. Demonstrate an understanding of microprocessor components and terminology.

Note: Program Standards and Benchmarks may be taken from:

1. Electronic Industries Association and Electronic Industries Foundation, "Raising the Standard: Electronics Technician Skills for Today and Tomorrow, [www.eia.org/eif](http://www.eia.org/eif)
2. American Electronics Association, "Setting the Standards and Working in New Ways," <http://aeacenter.org/index2.html>

# TRANSPORTATION

## General Mechanics

### General Requirements

**Standard I: Understand the basic procedures involved in the mechanics industry.**

*Benchmarks*

1. Apply shop and equipment safety rules including hazardous materials.
2. Apply first aid procedures.
3. Discuss the hazards of substance abuse in the workplace.
4. Identify and report unsafe shop conditions.
5. Demonstrate use of measuring devices (micrometer, etc.).
6. Demonstrate proper care and use of hand and power tools.

### Structural Analysis and Damage Repair

**Standard II: Demonstrate skill in analysis and care of the structure of a vehicle.**

*Benchmarks*

1. Inspect and identify suspension for damaged (worn) parts.
2. Inspect tires and wheels for damage, irregular wear and pressure.
3. Rotate and balance wheels.

### Mechanical and Electrical Components

**Standard III: Understand and apply the principles involved in the mechanical and electrical components of a vehicle.**

*Benchmarks*

1. Remove, replace and pack wheel bearings.
2. Remove and replace steering and suspension components.
3. Identify, remove and replace worn or damaged belts and hoses.
4. Test and install engine coolant, caps, and pressure test.
5. Identify, remove and replace engine temperature control components.
6. Check and/or change all fluids and filters per specifications.
7. Remove and replace brake system components.
8. Bleed and adjust brake system components.
9. Machine brake drums and rotors.
10. Rebuild wheel, master cylinders and calipers.
11. Identify and test emission control systems components, remove and replace as necessary.
12. Evaluate engine operation using testing equipment.

13. Remove, replace and adjust ignition components.
14. Check, remove and replace exhaust system components.
15. Evaluate operation of heating and air conditioning systems.
16. Perform repairs on heating system.
17. Identify, test, remove and replace fuel system component parts.
18. Test and evaluate automotive batteries using appropriate test equipment.
19. Identify, test and evaluate charging systems and components, remove and replace as required (includes use of appropriate diagnostic equipment).
20. Test and evaluate other electrical circuits and components using a voltmeter, ohmmeter, ammeter and test light.
21. Inspect, remove, replace and adjust clutch assembly and related components.
22. Remove and replace manual and automatic transmissions.

## **Engine**

### **Standard IV: Perform basic functions of engine care.**

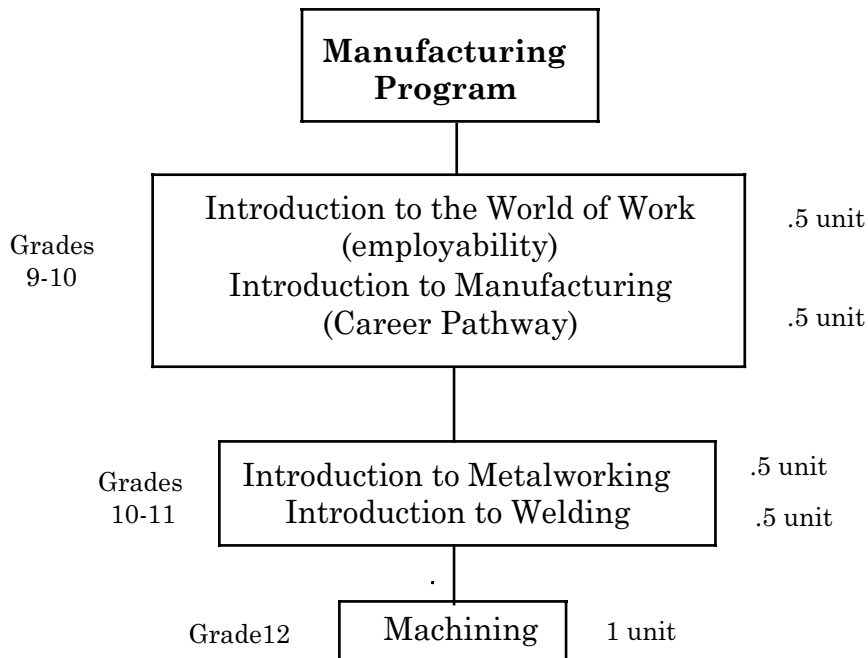
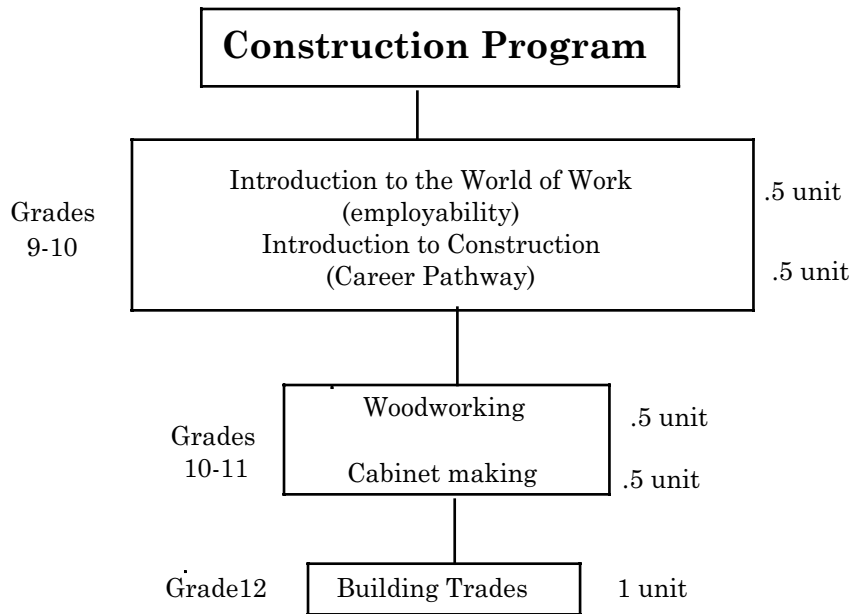
#### *Benchmarks*

1. Remove and replace engine.
2. Disassemble, evaluate and reassemble an engine.
3. Identify, test and evaluate starting systems and components, remove and replace as required (includes use of appropriate diagnostic equipment).
4. Cut threads with taps and dies, remove broken fasteners and repair threads.
5. Identify and specify SAE and metric fasteners.

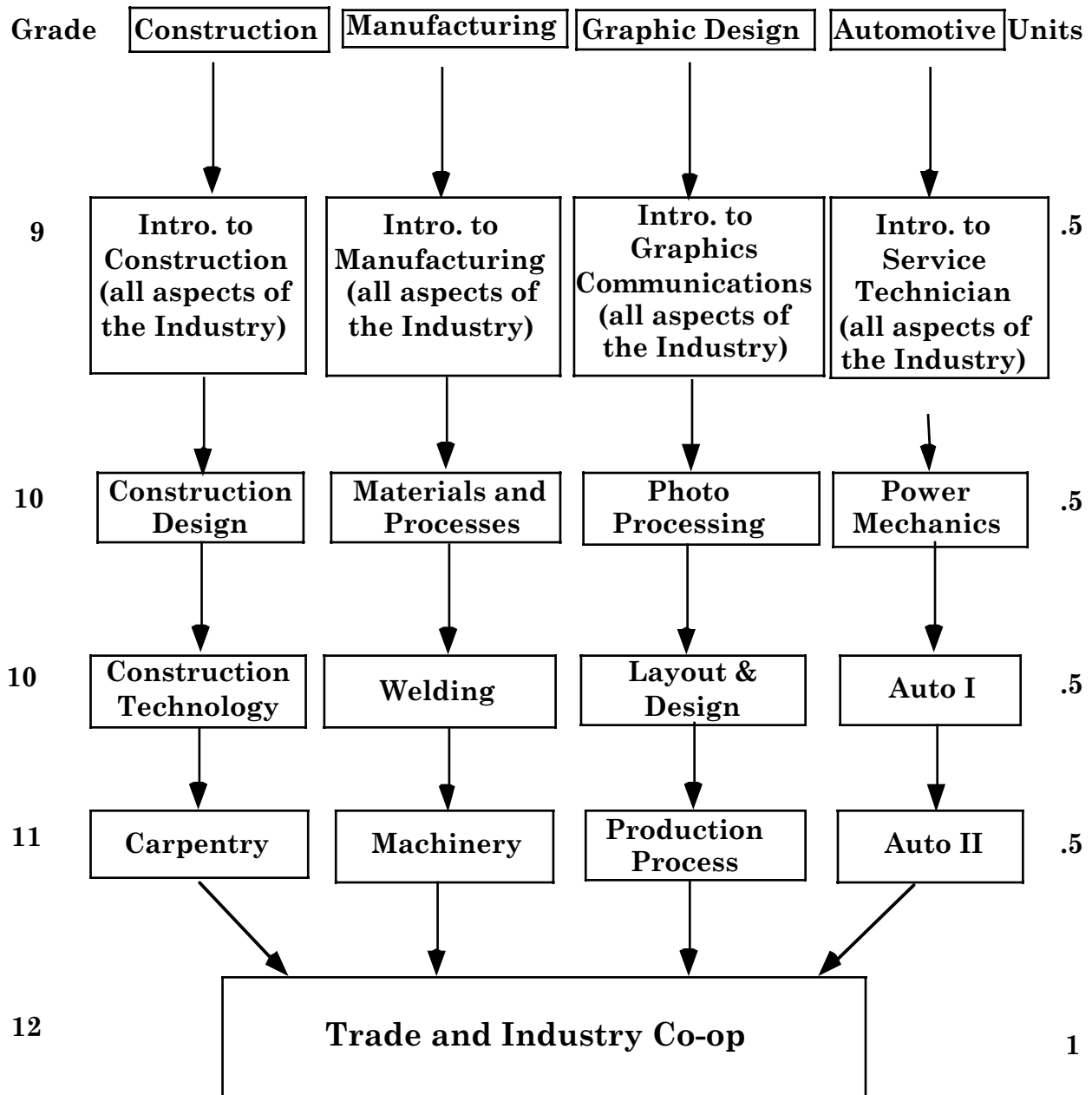
Note: Program Standards may be taken from ASE Program Certification Standards (NATEF, National Automotive Technicians Education Foundation, Inc.) 1999, <http://www.asecert.org/>





# Program Sequence with Core Employability Skills and Career Pathways Units



## Program Sequence Designed with Work Site Experience



# CONSTRUCTION (ABC)

Grade	Unit	
9-10	.5	<b>Introduction to World of Work</b> (employability) Introduction to free enterprise system, and general employability skill.
9-10	.5	<b>Introduction to Construction Careers</b> (Career Pathway) Orientation to the Construction Industry and all aspects of it and the career opportunities within.
		
10-11	.5	<b>Introduction to Basic Construction</b> Basic safety, Introduction to hand tools, introduction to power tools, introduction to blue print, and basic rigging.
10-11	.5	<b>Carpentry = Level One</b> Site prep, building materials, fasteners, floor system, form construction, and concrete handing.
		
11-12	.5	<b>Carpentry = Level Two</b> Wall systems, roof systems, water proofing, and field engineering principles.
11-12	.5	<b>Carpentry = Level Three</b> Stair construction, concrete finishing, exterior finishing, interior finishing roofing application.

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## Resources and Links

**Note: Program Standards and Benchmarks may be taken from:**

1. "What Manufacturing Workers Need To Know and Be Able to Do. . .," National Skill Standards Project for Advanced High Performance Manufacturing, National Coalition for Advanced Manufacturing, 1997, <http://www.bmpcoe.org/nacfam>
2. National Institute for Metalworking Skills, Inc., [NIMS@nims-skills.org](mailto:NIMS@nims-skills.org)
3. American Welding Society, [www.amweld.org/](http://www.amweld.org/)
4. Electronic Industries Foundation, [www.eia.org/eif/](http://www.eia.org/eif/)
5. American Mold Builders Association, [www.plasticsnet.com/amba/](http://www.plasticsnet.com/amba/)

\*These Standards and Benchmarks are taken from PIA PrintED Accreditation for Printing and Graphic Arts Programs, Presented by Printing Industries of America, Inc., <http://www.printing.org/>